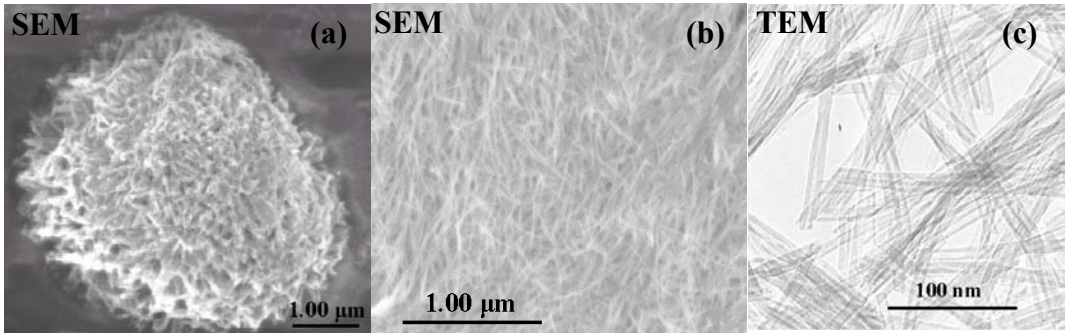
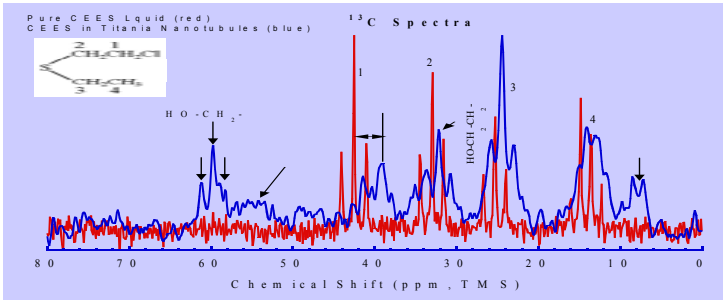
Nanotubular Reactor for Decontaminating Chemical Warfare Agents

Yue Wu, University of North Carolina-Chapel Hill, DMR-0139452

Storing gas molecules in nanocontainers offers a unique approach for investigating physical phenomena in one dimension as well as for applications. Unlike nanoparticles, which pack densely into large aggregates with low effective surface area, nanotubules cannot be packed densely and remain fully porous on all length scales even after aggregation. Consequently, gas molecules can be trapped on a large area of available surface both inside and outside the tubes. By controlling the surface chemistry, chemical warfare agents can be decomposed effectively upon adsorption on such surfaces.



Scanning (a,b) and transmission (c) electron micrographs of our synthesized titania nanotubules. Such nanotubules pack into micro-sized particles (a) but such particles are porous (b) and the tubes (c) are accessible to gas molecules



Nuclear magnetic resonance spectra demonstrate that mustard gas molecules trapped in titania nanotubules decompose into non-harmful products.

Nanotubular Reactor for the Decontamination of Chemical Warfare Agents

Yue Wu, University of North Carolina-Chapel Hill, DMR-0139452

Education:

Two undergraduates (Thomas Sünner and James Spence) and two graduate students (Shenghua Mao and Harsha Kulkarni) contributed to this work. James Spence was an REU student and has been working on this project since his sophomore year. Thomas Sünner was an exchange student from Germany and has now obtained his diploma degree and started his graduate school study in Germany. Both Shenghua Mao and Harsha Kulkarni are still working at the PI's lab on this project.

Societal Impact:

The approach of using nanotubules rather than nanoparticles for chemical reactions can lead to an efficient method for the decontamination of chemical warfare agents and cleaning up other pollutants in our environment. The synthetic approach used can lead to products that are economically viable.